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DOI

[10.1080/14659891.2022.2070876](https://doi.org/10.1080/14659891.2022.2070876)

Publication date

2023

Document Version

Final published version

Published in

Journal of Substance Use

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[Link to publication](#)

Citation for published version (APA):

Liu, Y., van den Wildenberg, W. P. M., Ridderinkhof, K. R., & Wiers, R. W. (2023). Combining implementation intentions and monetary incentives to reduce alcohol use: a failed generalization to a public bar context. *Journal of Substance Use*, 28(4), 550-567. <https://doi.org/10.1080/14659891.2022.2070876>

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Combining implementation intentions and monetary incentives to reduce alcohol use: a failed generalization to a public bar context

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ABSTRACT

Background: Implementation intentions have been demonstrated to reduce alcohol use in retrospective self-report measures. It remains unclear, however, whether they can moderate drinking in a challenging naturalistic context. We examined this by studying the effects of implementation intentions on alcohol use in a bar.

Methods: One hundred and twenty-one participants visiting a local bar were randomized over three conditions: control, motivational trigger, and motivational trigger plus implementation intentions. Those in the motivational trigger group were motivated to reduce drinking, and the combined intervention group made additional alcohol-related implementation intentions. We assessed participants' pre- and post-intervention breath alcohol concentrations, their post-intervention drinking behavior over one hour, and measures of trait impulsivity and reward sensitivity. To predict post-intervention drinking, multiple hierarchical regression was used.

Results: Neither the motivational trigger nor the added implementation intentions reduced drinking. Across treatment groups, trait impulsivity predicted alcohol consumption.

Conclusions: The present study showed that motivational trigger and implementation intentions failed to reduce alcohol use in a naturalistic setting. Potential reasons, implications, and limitations are discussed. This first attempt demonstrates that implementation intentions aimed at moderation are not as easily implemented in a public high-risk context.

ARTICLE HISTORY

Received 21 December 2021
Accepted 23 April 2022

KEYWORDS

Alcohol; implementation intentions; motivation; self-control; bar study

Introduction

Alcohol-related morbidity and mortality are severe global problems that come with huge social, health, and economic costs (Rehm et al., 2009; White et al., 2020). Interventions aimed at reducing alcohol use and relapse rates are therefore needed. To change drinking behavior, although forming a good intention is an important predictor, intentions are relatively weak predictors of actual behavior, the so-called intention-behavior gap (Webb & Sheeran, 2006). Implementation intentions have been developed to fill this gap and have been broadly applied in health psychology (see review: Kompf, 2020; McWilliams et al., 2019; Vilà et al., 2017). Implementation intentions specify when, where, and how behavior will be enacted in specific if-then plans (i.e., if I am in situation X, then I will do Y; Gollwitzer, 1999). The theory underpinning implementation intentions is that it first increases the salience of cue X in the context by mental representation (Chatzisarantis & Hagger, 2010), followed by automatic activation of the associated behavior when X is encountered (Gollwitzer & Sheeran, 2006). In this way, it reduces the demand for self-control to reduce drinking, which can be impaired in problematic alcohol users (see, Liu et al., 2019; Smith et al., 2014). In a recent meta-analysis, implementation intentions had an overall small (pooled Hedges' g of 0.31) but significant effect in reducing

alcohol use (Malaguti et al., 2020), despite null findings in some included studies. All included studies in their meta-analysis concerned changes in self-reported daily life alcohol use over time. The present study examined whether implementation intentions could also help to moderate drinking in a public bar context.

Despite indications of a small moderating effect of implementation intentions on alcohol use, there are several reasons to further examine the effect of implementation intentions in reducing alcohol use in a real-life context. First, implementation intentions may reduce alcohol use over a certain period through different mechanisms: by reducing high-risk situation visits or by reducing drinking in such a context. Frequently used composite measures such as drinks per week cannot disentangle these different mechanisms. This is critical as strategies to avoid visiting high-risk drinking scenarios differ from those to limit drinking once it started. Until now, only Moody et al. (2018) clearly stated that implementation intentions reduced alcohol consumption by limiting quantities per episode, in addition to a small effect on drinking frequency. Second, and related to the first point, many people wish to restrain alcohol use without totally avoiding high-risk situations, probably related to social goals (e.g., after-work drink

with colleagues) or one's overconfidence in resisting temptation (Nordgren et al., 2009). However, once one is exposed to a context full of alcohol-related stimuli, it may be too late to activate and enact restraint goals. Third, research findings on *typical* alcohol use sometimes conflict with those studying alcohol use *in a specific situation*, which may be attributable to factors exclusive to a bar context (e.g., peer influence, context priming effect; Larsen et al., 2012; Stanesby et al., 2019). This is the first study to examine the efficiency of this intervention in reducing alcohol use in a highly tempting environment.

According to the health action process approach, there are two stages involved in health behavior change, namely the motivational phase to form an intention and the volitional phase to plan and take actions (Sutton, 2005). Accordingly, developing an alcohol restraint intention is a prerequisite to implementing it. Considering the highly attractive nature of a bar environment, one must preplan to form a self-involved restraint goal. We adopted the strategy developed by Muraven et al. (2002), in which participants were informed that better performance on a driving simulator would later gain them a reward. Two changes were made: 1) the driving simulator was changed into a computer driving game for feasibility in a bar; 2) the driving game was performed twice instead of acting as an upcoming challenge. The principle is that only by limiting alcohol use, a reward can be secured.

As a secondary concern, personality factors that may influence alcohol use in a naturalistic environment were also examined. For instance, impulsivity was associated with drinking speed and ineffectiveness of restraint measures in a *hot* context (R. Wiers et al., 2010); sensation seeking was positively correlated with alcohol-related problems (Hittner & Swickert, 2006) and alcohol use in the naturalistic context (Legrand et al., 2007).

To summarize, we developed and tested a brief motivational intervention in isolation and in combination with implementation intentions to reduce drinking in the bar.¹ Meanwhile, some personality characteristics that may be related to drinking behavior were also examined. We hypothesized that: 1) there would be main effects of the two manipulations, such that individuals who were motivated to drink less would indeed drink less than controls; and individuals who formed alcohol-related implementation intentions would drink less than those who did not; 2) the higher the impulsivity and sensation-seeking scores, the more alcohol would be consumed in the hour after the brief intervention.

Methods

Participants

Taking a pooled effect size Cohen's *d* of 0.65 (Gollwitzer & Sheeran, 2006), alpha of 0.05, and power set to 80%, our required sample size was 100.² One hundred and twenty-one participants were recruited, while they were drinking in a pub on campus, with the majority being students and university employees. They met the following criteria: 1) aged between 18–35; 2) drank no more than 4 standard drinks before the test; 3) planned to drink alcohol in the next hour and stay in the pub for another 80 minutes (i.e., the time needed for testing); 4)

no tourists.³ Participants were randomly assigned into one of three conditions with an unpredictable allocation sequence: control, monetary motivation, and monetary motivation plus implementation intentions (“dual intervention group”). Multiple participants from the same drinking group were allowed to participate.

Materials

Questionnaires

The Alcohol Use Disorders Identification Test-Consumption (AUDIT-C, Bush et al., 1998) was used to assess typical alcohol use. AUDIT-C reliably identifies individuals who are hazardous drinkers and are likely to have alcohol use disorder (Frank et al., 2008), with a Cronbach's alpha of 0.76 (Barry et al., 2015). Craving for alcohol was tested with a 5-items visual analogue scale (Adams et al., 2017). A mean score was calculated by dividing the sum score by the count of entries, and Cronbach's alpha was 0.74 in the current study. The short Substance Use Risk Profile Scale (SURPS, Woicik et al., 2009) was used to assess four personality traits: hopelessness, anxiety sensitivity, impulsivity, and sensation seeking. Cronbach's alphas for these subscales were 0.73, 0.85, 0.71, and 0.78 for the English version (Long et al., 2018), and 0.85, 0.69, 0.67, and 0.68 for the Dutch version (Malmberg et al., 2010). All text materials (online and paper) were prepared in these two languages.

Driving game: road lane splitter

The driving game called Road Lane Splitter was obtained from the Microsoft Store. On a laptop screen, a motorcycle is running at high speed through ever-changing traffic. Participants use keyboard buttons A/D or Left/Right to control the motorcycle. Action control is needed to avoid colliding with other vehicles, and through hitting coins on the way, one can earn points. As this game was selected to trigger the alcohol restraint goal, game performance (e.g., number of coins collected) was not analyzed.

Alcohol and snack related if-then plans

Three examples of *if-situations* and *then-actions* were provided. The alcohol-related if-then sentences were adopted from Arden and Armitage (2012) (e.g., If my friend asks me to have another drink, then I will order a soft drink like soda instead of alcohol). To dissociate the demand characteristics influence from the intervention effect in the dual intervention group, the control and monetary motivation groups were asked to make irrelevant implementation intentions, i.e., the snack-related if-then plans (e.g., If I pass by a fast-food restaurant later tonight, then I will go home and eat something healthy). Participants could freely combine a pair of them and write it down or formulate their if-then plan (see Supplementary Materials S1, S2 for the full list).

Procedure

The experiment consisted of three stages (see, Figure 1). In stage one, participants in all three groups were given half a glass of water for mouthwash first, then filled out an online

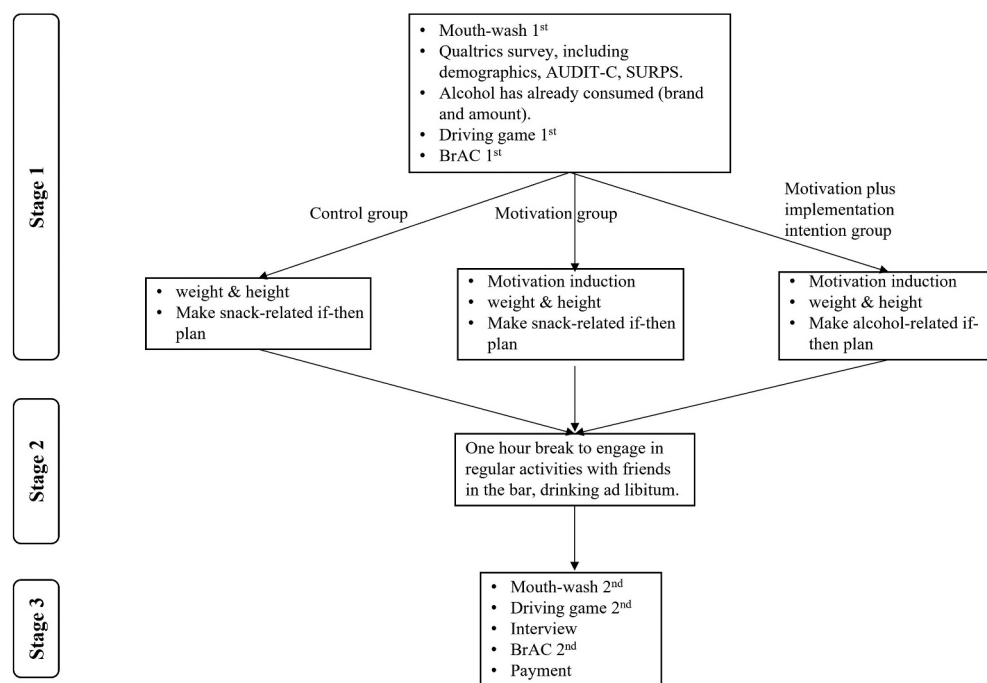


Figure 1. The procedure of the experiment. The experiment consisted of three stages with one hour of drinking in between. AUDIT-C: Alcohol Use Disorder Identification Test-Consumption, SURPS: Substance Use Risk Profile Scale, BrAC: Breath Alcohol Concentration.

survey, tested alcohol already consumed and breath alcohol concentration (BrAC1), and played the driving game for the first time. Next, the two intervention groups were told that: “You will play this driving game again one hour from now. If your performance improves (i.e., you collect more coins), your payment gets doubled for the post-drinking stage (i.e., €5 instead of €2.5). However, after playing the game for the first time, you will realize that it is a challenging game. Like real driving, your performance is likely to be negatively influenced by the consumption of alcohol.” Such monetary stimulation was designed to trigger the alcohol restraint goal. Next, before asking the dual intervention group to make the plan they were told that: “people are more likely to stick to their plans when they formulate an ‘if-then’ sentence.” The control and monetary motivation groups were asked to make snack-related if-then sentences with the instruction: “Drinking and healthy eating behavior are closely related. For example, if you feel hungry when leaving the bar, you might want to go to a snack bar and buy something that is not healthy. To help you develop a healthier eating habit, we will ask you to formulate a snack-related if-then sentence.” To make the snack-related implementation intentions more credible, we intentionally inserted the weight and height questions into the motivation induction and implementation intentions formation.

In stage two, participants continued their bar visit, drinking *ad libitum* for one hour. In the meantime, the experimenter filled out the experimenter form (Supplementary Materials S3). To prevent foreknowledge about the experimental conditions, participants were asked not to talk with their friends about the experiment during drinking.

In stage three, participants were provided with water for mouthwash and played the driving game again. Afterward, a short interview was conducted (see details in Supplementary Materials S4). Participants were encouraged

to report as detailed as possible to the question “how much alcohol did you consume in the last hour” by mentioning the brands and corresponding amounts (e.g., a ¼ glass of red wine). Another question related to the analyses was: “how much do you think you would have drunk during the last hour if you would not have participated in the experiment.” The categorical variable *drink less than planned* (yes/no) was created by comparing answers to these two questions. The experiment ended up with BrAC2. There was no debriefing as the participants were not misled.

As payment, participants received €2.5 for stage one and stage three each, and another €2.5 if their driving performance improved. The procedure was approved by the local Institutional Ethical Review Board (2018-COP-8774) and complied with institutional guidelines and the declaration of Helsinki. Written informed consent was obtained from all subjects.

Data preparation and analyses

Our main dependent variable concerned alcohol consumption during stage two. It was estimated in two ways: changes in BrAC (i.e., ΔBrAC)⁴ and participants’ self-reported drinking amount in grams of ethanol, which was calculated by adding the product of self-reported drinking amount, volume, and alcohol by volume information of each provided drink (see the drink menu in Table S1). Parallel hierarchical regressions were performed on these two outcomes with predictors entered in the following sequence: (step 1) age, sex, craving, AUDIT-C, alcohol already had before the session,⁵ impulsivity, and sensation-seeking; (step 2) two dummy variables: motivational trigger and implementation intentions, for which a value of 1 (otherwise 0) was assigned when alcohol restraint motivation was triggered, and alcohol-related implementation intentions were made.

Some secondary analyses were also performed: 1) a Chi-square test and a series of one-way ANOVAs to compare demographics, typical alcohol use, and personality traits across groups; 2) validation tests of self-reported alcohol consumption by their correlations with BrACs; 3) within the dual intervention group, an independent t-test to compare alcohol consumption of those made self-generated implementation intentions versus those who chose experimenter-provided ones; 4) a Chi-square test to compare the distribution/relative proportions of *drink less than planned* across groups; 5) a series of t-test to compare compliers with non-compliers across groups (i.e., those who made invalid if-then plans, e.g., if I was offered a drink, then I will accept it) in terms of typical alcohol use, personality traits, and drinking in the situation.

Results

Sample

Those who did not complete the whole experiment ($N = 6$) were excluded and the analyses were conducted with the remaining 115 participants. Of the 115 participants, 25 were non-compliers (control: 11; motivation: 7; motivation plus implementation intentions: 7; total compliance rate: 78%). We ran parallel analyses with and without those 25 participants (i.e., intention-to-treat and per-protocol analysis, Norman et al., 2019), and presented the results (which largely converged) in the main text and Supplementary Materials (Table S3-S4) separately.

Randomization check

A Chi-square test and one-way ANOVA indicated that the three groups were comparable in terms of demographics (i.e., sex, age, education level, body mass index), typical alcohol use (i.e., AUDIT-C), and personality traits (i.e., impulsivity and sensation-seeking), all p 's = ns (see, Table 1).

Main analysis: hierarchical regression in predicting post-intervention-hour drinking

Given that the results converged largely between self-reported and BrAC-based measures, we present them in the main text and Supplementary Materials (Table S2), separately. Variables

entered the regression model were first checked for multicollinearity. Variance inflation factors (VIF) for all variables were below 1.4, which indicated no serious multicollinearities among the predictors (Hair et al., 2010). Step 1 analyses indicated that the variance accounted for (R^2) with the first seven independent variables (sex, age, craving, AUDIT-C, alcohol already had, impulsivity, and sensation-seeking) equaled 0.18 (adjusted $R^2 = 0.13$), which differed significantly from zero ($F(7, 107) = 3.38, p < .01$). The only significant predictor was impulsivity ($\beta = 0.21, p < .05$) and the effect of sex was marginally significant (males drank more than females: $\beta = 0.19, p < .1$). In step 2, motivational trigger and implementation intentions were entered into the regression equation. The change in variance accounted for ΔR^2 was equal to 0.004, which did not differ significantly from zero ($F(2, 105) = 0.26, p = ns$). Two predictors that contributed significantly to the explanation of alcohol consumption were again impulsivity ($\beta = 0.20, p < .05$) and sex (males drank more than females: $\beta = 0.20, p < .05$). In contrast, the effect of motivational trigger ($\beta = 0.03, p = ns$) and implementation intentions ($\beta = -0.07, p = ns$) were non-significant. The unstandardized regression coefficient (B), standard error of B , and the standardized regression coefficient (β) for predictors at each step are displayed in Table 2.

Secondary analyses

First, BrAC1 was correlated with self-reported alcohol already had before the session ($r = 0.66, p < .01$), and Δ BrAC was correlated with self-reported drinking during the observation hour ($r = 0.59, p < .01$), cross-validated these measures. Second, within the dual intervention group, individuals who formed self-generated implementation intentions ($N = 12$) and those who chose experimenter-provided ones ($N = 25$) showed comparable alcohol consumption after the intervention ($M = 19.40$ grams, $SD = 11.04$ grams vs. $M = 15.89$ grams, $SD = 10.58$ grams, $t(35) = -0.93, p = ns$). Third, the relative proportion of *drink less than planned* differed significantly between groups (Control: 5% vs. Motivation: 15.4% vs. Motivation plus implementation intentions: 35.1%, $\chi^2(2, N = 115) = 11.78, p < .01$). Specifically, participants who received dual interventions scored higher on the question *drank less than planned* than the other two groups (*Adjusted Residual* = 3.2, $p < .01$). Fourth, the 25 non-compliers were

Table 1. Comparisons of demographics, alcohol use, and personality traits between three groups.

	Control (N = 39)	Motivational trigger (N = 39)	Motivational trigger + Implementation intentions (N = 37)	F	p
Male (%)	15 (38.5)	17 (43.6)	20 (54.1)	$\chi^2 = 1.93$	ns
Age	24.08 (4.41)	23.41 (3.52)	23.14 (3.23)	0.63	ns
BMI	21.81 (2.47)	21.83 (2.25)	22.98 (2.92)	2.57	ns
Education Level	5.00 (1.32)	4.67 (1.46)	4.86 (1.42)	0.55	ns
AUDIT-C	5.69 (2.08)	6.46 (2.20)	6.08 (1.89)	1.36	ns
BrAC-1(‰)	0.23 (0.26)	0.14 (0.16)	0.18 (0.26)	1.21	ns
Alcohol already had (ethanol in grams)	14.24 (11.70)	13.19 (10.00)	13.14 (10.73)	0.13	ns
Craving SURPS	59.41 (17.77)	59.42 (16.15)	54.87 (20.56)	0.78	ns
Impulsivity	10.08 (2.74)	10.90 (2.17)	10.51 (1.98)	1.22	ns
Sensation seeking	16.51 (3.27)	17.41 (3.19)	16.73 (2.87)	0.88	ns
Hopelessness	11.97 (2.99)	12.72 (2.93)	12.30 (3.11)	0.60	ns
Anxiety Sensitivity	12.46 (2.42)	11.85 (2.28)	12.16 (2.04)	0.73	ns

Mean (Standard Deviation), Education level, 4: Higher professional education middle level/MBO, 5: Higher professional education high level/HBO, ns: non-significant

Table 2. Hierarchical regression predicting post-intervention-hour alcohol intake.

Variable	<i>B</i>	SE <i>B</i>	β
Step 1			
Sex	4.08	2.08	0.19 [†]
Age	-0.40	0.28	-0.14
AUDIT-C	0.79	0.54	0.15
Craving	0.08	0.06	0.14
Alcohol already had (ethanol in grams)	0.06	0.09	0.06
SURPS-IMP	0.97	0.43	0.21*
SURPS-SS	-0.04	0.34	-0.01
Change in R ²	0.18		
F for change in R ²	$F_{(7, 107)} = 3.38, p < .001$		
Step 2			
Sex	4.28	2.12	0.20*
Age	-0.41	0.28	-0.14
AUDIT-C	0.76	0.55	0.14
Craving	0.08	0.06	0.13
Alcohol already had (ethanol in grams)	0.06	0.09	0.06
SURPS-IMP	0.95	0.44	0.20*
SURPS-SS	-0.06	0.34	-0.02
Motivational trigger	0.69	2.39	0.03
	-1.72	241	-0.07
Change in R ²	0.004		
F for change in R ²	$F_{(2, 105)} = 0.26, p = ns$		

* $p < .05$, [†] $.05 < p < .1$; *B*: unstandardized beta coefficient, SE *B*: standard error for the unstandardized beta, β : standardized beta coefficient, SURPS-IMP: impulsivity subscale of the Substance Use Risk Profile Scale, SURPS-SS: sensation-seeking subscale, Motivational trigger: whether motivated to drink less or not, Implementation Intentions: whether the alcohol-related if-then plan was made or not

more impulsive than the 90 compliers ($M = 11.36, SD = 2.41$ vs. $M = 10.26, SD = 2.26, t(113) = 2.13, p < .05$), but comparable concerning other factors (all p 's = ns, **Table S5**).

Discussion

The current study examined the effectiveness of two brief interventions to restrain alcohol use among people in a public bar. Interventions included a motivational trigger in the form of a monetary incentive and the formation of implementation intentions. At the group level, the interventions did not effectively reduce alcohol use compared to the control group. However, more participants in the dual intervention group reported having consumed less alcohol than planned in comparison with the other two groups. In addition, we found that impulsive individuals and males drank more alcohol within the post-intervention hour. What's more, people in compliance with making valid if-then plans were less impulsive. In the following sections, we discuss: 1) why our interventions did not work; 2) secondary findings; 3) limitations and suggestions for future studies.

It is important to form a relevant intention before implementing it. In the present study, the intention to reduce alcohol use was motivated by the prospect of monetary gain (€2.5 in the driving game). As the manipulation check question was intentionally omitted to prevent reactivity, we can only speculate that the effect of this manipulation may have been hampered considering the following factors. First, we did not explicitly tell the participants that for the monetary gain they had to restrain their alcohol use, but emphasized a negative relationship between drinking and driving. Some participants may not have linked this information to their situation. Second, according to self-determination theory, autonomous motivations serving personally relevant goals yield better health-related intentions than externally controlled

motivations (Deci & Ryan, 1987, 2008). Here, the chance of winning a small monetary reward may be a self-relevant but insignificant incentive to be internalized and acted upon, since most of the drinks cost more than 2.5 euros. However, most of the participants included were college students, who customarily do drink but generally have a limited budget. Therefore, when extending the current intervention to a higher socioeconomic status population, increasing the significance of this incentive is highly recommended. Third, the selected driving game was not individually tailored, and participants' gaming experience may have biased their beliefs in performing worse under intoxication.

Regarding implementation intentions, although previous studies have demonstrated that they effectively reduced alcohol consumption (e.g., Arden & Armitage, 2012; Armitage & Arden, 2016; Norman & Wrona-Clarke, 2016), we did not observe this in a naturalistic setting. This can be interpreted in two ways: either implementation intentions can only reduce drinking through avoiding highly tempting situations, or they can also limit drinking in a tempting context, but we failed to detect this. The available evidence is inconclusive to determine which possibility is most likely true, and we interpret the discrepancy with previous findings as follows.

First, the observation period may have been too short to allow for the formulated cue to occur (e.g., being offered a drink), which left the linked response inactive. However, according to the spill-over effect of implementation intentions, cues similar to the formulated one can also activate the associated behavior (Bieleke et al., 2018).

Second, most of the participants chose experimenter-provided rather than self-generated plans (25:12). However, it was documented that these two modalities were similarly effective in changing unhealthy behavior (Armitage, 2009), and by making use of Table 1 in Malaguti's meta-analysis (Malaguti et al., 2020), we found that the effect size of experimenter-provided plans did not differ significantly from self-made ones in changing drinking behavior (0.37 vs. 0.18, $t(15) = -1.85, p = ns$). Furthermore, it was assumed that the potency of self-generated plans may be significantly undermined by a low level of compliance (Armitage & Arden, 2012), which was confirmed here by the sharp contrast of the compliance rate with experimenter-provided ones (37.5% vs. 100%). Additionally, the so-called experimenter-provided plan was a volitional help sheet that could give participants guidance as well as freedom for plan-making. Taking all these into account, we argue that by no means does the lack of an intervention effect likely attribute to many participants choosing pre-specified over self-generated plans.

Third, when one is exposed to a *hot* context full of alcohol-related stimuli, it is quite challenging to activate and enact the alcohol restraint goal. A recent study developed a just-in-time intervention to prevent smoking relapse by sending participants reminders of making implementation intentions during vulnerability windows (Huh et al., 2021). This may be an alternative to implementing interventions on the spot.

Finally, though an overall significant effect of implementation intentions in reducing drinking has been confirmed in a recent meta-analysis (Malaguti et al., 2020), the effect was small and there is large between-study heterogeneity (i.e., 8 out

of 16 included studies reported nonsignificant results). Factors that may have moderated research findings should be systematically assessed in the future (e.g., habit strength, dependence severity, willingness to quit, mode of delivery, etc. Hagerman et al., 2021; Hagger et al., 2016; Onken et al., 2014).

Despite these negative findings, participants in the dual intervention group reported higher scores on the question “*drink less than planned*” than the other two groups. One explanation is that our intervention showed some promise, but it was not manifested as a significant group-level difference. A majority of the participants (24/37) in the dual intervention group did not report such a disparity, for whom more effective interventions are called for. Alternatively, participants may have said that they drank less than planned because of social desirability bias (respondents answer questions in a way that will be viewed positively by others, Nederhof, 1985). This possibility can be largely ruled out, however, as only one out of the 21 participants who reported drinking less than planned was aware of the experiment’s aim (i.e., to help them reduce alcohol consumption).

Concerning the secondary hypotheses, we found that the relationship between impulsivity and typical alcohol use, as has often been reported (e.g., Stautz & Cooper, 2013) can be generalized to drinking on a specific occasion. Interestingly, in the model with compliers only, this relationship disappeared (Table S4). Moreover, non-compliers were more impulsive than compliers. Together, these findings suggest that people who scored higher on impulsivity may be less willing and less likely to change their behavior through this preventive effort. More effective interventions specifically targeting this population are required. There is some evidence that cognitive bias modification may have a stronger effect in impulsive individuals (Weckler et al., 2017), but this also requires motivation from participants (R. W. Wiers et al., 2018).

Some limitations should be acknowledged. First, our data collection finished before the addiction-related meta-analysis by Malaguti et al. (2020), according to which more participants should have been recruited than referring to the effect size in the general health-related domain by Gollwitzer and Sheeran (2006). Second, drinking speed in a similar context without intervention was unavailable, which made within-group pre-post intervention comparison impossible. We mention this as some laboratory studies found that both the intervention group and the control group reduced undesirable behavior compared to their baseline, albeit no group difference in posttest (Caudwell et al., 2018). This is an unsolvable dilemma, as it is unrealistic to produce identical drinking episodes with and without interventions in a field study.

In sum, in line with the two-stage theory in the health action process approach (i.e., motivation buildup before intention execution), we tend to believe that the failed intervention was mainly due to unsuccessful motivation triggering. Triggering alcohol restraint goals once drinking has started has long been considered a challenge (Keller, 1972). Our assumption can be examined by comparing the intervention effect within those who had not started drinking yet versus those who had started. In addition, instead of recruiting random patrons from a bar, individuals who have set themselves a temporary alcohol

restraint goal may be more likely to benefit from it (such as participants of a voluntary abstinence challenge, Albertella et al., 2021).

Conclusions

The current proof-of-principle study tested an unobtrusive motivational intervention in combination with forming implementation intentions to reduce alcohol use in a public bar context. These brief interventions did not lead to reduced drinking. A failure to generalize a lab-based implementation-intention intervention to a real-life context is important to report, as it demonstrates that intentions to drink less are not as easily formed and implemented in a public bar as in a controlled trial. It could imply that the reported effects of implementation intentions are more due to avoiding high-risk situations than due to moderation in high-risk situations. Developing effective interventions targeted at changing excessive drinking behavior in a *hot* context remains a challenge.

Notes

1. This is a proof-of-principle study rather than a randomized controlled trial, as we tested short-lived changes in behavior in a non-clinical sample (c.f., Boffo et al., 2019).
2. It is worth noting that the meta-analysis with a specific focus on addiction (Malaguti et al., 2020) was only published after we have completed our data collection. Therefore, the relatively small effect size of implementation intentions in reducing alcohol use was not referred to when determine the sample size here.
3. Compared to locals, they should be less likely to compensate their good times to comply with the instructions.
4. $\Delta\text{BrAC} = \text{BrAC}_2 + 0.15 - \text{BrAC}_1$, where 0.15 is the hourly metabolism rate of alcohol for moderate drinkers (Jones, 2010).
5. This was BrAC_1 in ΔBrAC -based regression, and grams of ethanol already had in self-reported measure-based regression.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

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